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ABSTRACT

Five-year-old children's activity choices were examined in an early childhood classroom setting designed to foster interactive microcomputer activities. It was hypothesized that engaging and sustaining the children's active involvement with interactive computer experiences would be very difficult, due to their limited academic skills. Further, it was expected that 5-year-olds would not develop even the simplest programing skills. The primary computer activity made available to the children was Keystroke LOGO. They were additionally provided opportunities to become involved with various materials, such as kindergarten blocks, colored cubes and pattern cards, crayons, and small stuffed animals. Ten children were enrolled in the first of three 8-week cycles of weekly 90-minute sessions, 12 were enrolled in the second, and 11 in the third cycle which was for children who showed a sustained interest in computer experiences during the first two cycles. All sessions were videotaped and additional data were collected through tape recordings, activity records, and anecdotal records. Findings are reported which concern the basic characteristics of the cycles, the nature of children's involvement, children's learning strategies, computer "wisdom," and teachers' strategies. It is concluded that, contrary to the initial hypotheses, some 5-year-old children will choose interactive microcomputer activities, but none will develop programing skills in even the simplest form, although directly taught at timely moments. (RH)

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KINDERGARTENERS HAVING MICROCOMPUTER EXPERIENCES: A Descriptive Study(1)

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INTRODUCTION

The growing mystique about the value of computer experiences for young children provoked the researchers to undertake this study in the fall of 1983. This mystique seemed to include the following elements of a fairyland view of the importance of the new technology in the lives of children between the ages of three and seven:

1. They can learn to program and love it.
2. They will develop their logical thinking skills through learning to program.
3. They can learn a variety of school skills joyfully.
4. They will develop a degree of computer literacy which many adults find elusive.
5. The earlier we introduce computers, the less awed the children will be.

Clearly, the bandwagon was gaining momentum with the promise of success in a broad range of developmental and learning areas, irrespective of educational philosophy and values. (2) Two computer groups fueled the momentum of this bandwagon, those committed to LOGO as the language for beginning computer learners and others who were supporters of the use of early childhood commercial software to foster the development of school skills. Although these proponents of computer use represented two opposing views of curriculum, the distinction was unclear both in the literature and at conferences focusing on early childhood computer use. (3)

As the bandwagon gained momentum, a counterforce of early childhood professional leaders was beginning to challenge the growing acceptance of the idea that when it comes to computers, what's good for older children is good for younger children.(4) This counter view placed strong emphasis on the importance of the concrete world to young learners as a foundation for developing competence with the world of symbols.

The researchers were committed to the underlying ideas of this latter view, that young children's learning is strongly dependent on their experiences of manipulating the concrete world. Our interest centered on whether young learners could use computer experiences as "grist for their learning mill" with the same sustaining interest as has been documented in

their use of blocks, puzzles, dramatic play and graphic and plastic art materials. A great deal is already known about the ways in which children use these traditional early childhood classroom materials in their learning activities. Little has been documented about how young children use microcomputer experiences for their own learning purposes. How do they explore the possibilities, coordinate what they already know with what they are learning, and how do they use this new technology in their own world, toward their own ends?

In the following study we chose to examine what young children will do with computer opportunities in a multiple-activity early childhood setting purposely designed to foster interactive microcomputer activities.

NEED FOR STUDY

Early Childhood Perspective

The advent of school-affordable microcomputers has resulted in an increase in the placement of computers in early childhood classrooms, despite the fact that these settings serve the academically unskilled. At the time this project was initiated in the fall of 1983, there had already been one major conference on the use of microcomputers with young children, another was being scheduled, and several early childhood sites were showcasing their efforts to bring microcomputers into early childhood settings.(5) A theoretical foundation for selection of computer experiences at these test sites was notably absent.

Although many educators view the early childhood field as representing a single philosophy, in fact, educational services for young children reflect differing points of view about child development, learning and curriculum. An analysis of the theoretical implications of three major early childhood curriculum approaches, (a)cultural training or behaviorist approach, (b) the cognitive developmental or constructivist approach, and (c)the psychosocial approach clearly indicates different directions for computer use. (6) Each of these approaches require different emphases in terms of curriculum activities and teaching roles and strategies due to different assumptions about what's worth learning and the learning and developmental process. (7)

The lack of a stated acknowledgment of the distinctive difference between the tutor (drill and practice), tool, and tutee (interactive) functions of computer experiences by the groups reporting use of computers with young children poses

a serious problem. (8) The critical question is how we can use research findings from test sites that do not discriminate selection of software and teaching strategies based on a theoretical commitment. We need to study models developed from a theoretical base.

From Computer Education Perspective

LOGO was and continues to be judged the most age-appropriate computer language for the youngest computer users. LOGO in the graphics mode is depicted as an interactive computer experience which supplies feedback to the user that is sufficiently immediate and direct to suit the style of young learners. It is described as a computer learning environment which will help develop problem identification and problem solving skills associated with intelligent use of the technology. (9)

There are clear cut opposing views on the ability of young children to develop programming skills. As experienced early childhood professionals, we believed that most young children, at least through the age of six, do not have the capacities to use LOGO as a programming language. If programming refers to the ability to develop an idea, use the procedural mode to write the commands necessary to execute the idea, and then test the procedure, making changes or debugging as needed, then it was our contention that children within this early childhood age range would not learn to program. Their limited ability to conceptualize part-whole relationships and to understand the elements of plane geometry and measurement required in LOGO graphics would prohibit successful programming. We do not accept the notion that programming skills are evident when a child copies a series of commands into the programming or edit mode that have already been recorded from explorations in the immediate mode.

Although there were many claims that young children were writing programs, the problem of identifying the real LOGO programming abilities of young children was being confounded by the use of didactic teaching practices. One of the latest Computing Teacher issues includes a testimonial letter from a first grade teacher about the value of a LOGO workbook which is being used "as the bible" with the whole class. The teacher further notes that this workbook has succeeded in helping to effectively use LOGO to teach kindergarten and grade 1 children to use the protractor. (10) Such practices as those implied in this letter run counter to the claim that LOGO offers a computer environment in which children can discover and construct understandings

of geometric relationships, mathematical ideas and programming concepts.

What is missing in most of the LOGO literature is descriptive information on teaching roles and strategies, especially for young beginners with little or no reading and mathematical computational skills. The notion that in a LOGO environment teachers facilitate subtly without getting in the way of children's discovery and problem solving processes poses serious challenge to teachers of nonreaders and beginning readers.

Summary

Important unanswered questions about use of microcomputers with young children include:

1. Can the microcomputer offer more than entertainment and attractive drill practice for young nonreaders and beginning readers? If so:
    a. What kinds of exploring and experimenting will occur when young children are presented with computer experiences which offer them an opportunity to control their experiences?
    b. What kinds of initial and continuing learning behavior do young children produce when presented with software that requires them to use a keyboard to control events on the monitor, as in a drawing program?
    c. How do children relate to each other and to the adult in a computer-rich environment?
2. How much direct teaching is required to help children achieve independence with interactive software?
3. What variations in teaching strategies are likely to occur when teaching is adapted to different learning styles?
4. What is the sustaining power of computer experiences as compared to other classroom materials?
5. Can we document the value of computer experiences for early childhood related to curriculum or developmental goals?

In educational research, the bottom line is ultimately, "What is the payoff in terms of school progress?" Before we can begin to answer this question for early childhood, it is necessary to design theoretically-based models for study.

REVIEW OF RESEARCH

A review of research completed in the early spring of 1984 for the first summary review of this study revealed little research evidence about any of the aspects of young children using microcomputers. As another reviewer concluded "There is much more rhetoric than solid evidence".(11) The most current summaries of research, theory and practice indicate that a few studies with a small group of young children have been done. (12) Studies that include young children in a mixed population of five to thirteen-year-olds offer very limited information and tend to be misleading because there is no distinction between the activity engagement of the younger nonreaders and beginning readers and the older, more academically independent children. (13)

Research has documented the following:

1. Young children can learn limited amounts of information and practice prereading and mathematics skills using attractive color graphics and music. Typical examples of what they can learn are the meaning of positional terms, matching alphabet letters, completing simple arithmetic problems and completing linear patterns of shapes. (14)
2. Some positive side effects can be associated with exposure to some computer activities. This includes increased experiences of sharing ideas, problem-solving and enhanced sense of confidence. (15)

PURPOSE

The purpose of this study was to answer the following questions:

1. Given a materials-rich, choice-making environment including maximum access to computer experiences, will five-year-olds use interactive computer activities with the same vitality as they use other, more familiar concrete kindergarten materials?
    a. If not, will we see behaviors more often associated with novelty toys, i.e. high initial interest and then abandonment?
    Or will we see behaviors more closely associated with television watching, i.e. passive receptivity?
    b. If so, what are the indicators that the microcomputer activities continue to be a vital learning experience? Vitality is reflected in choosing to actively engage, sustaining involvement through discovering how things work and using this knowledge to produce self-selected

outcomes.

2. What kinds of teaching strategies are required to initially engage five-year-old children in interactive experiences with the computer? Once children have engaged, are there strategies compatible with the LOGO environment for extending young children's microcomputer experiences to increase mastery?
3. Can we begin to describe learning outcomes without the use of standardized school achievement tests?

HYPOTHESIS

Based on five-year-olds' limited academic skills in the three R's, we hypothesized that in an environment where they had choices it would be very difficult to engage and sustain children's active involvement with interactive computer experiences. Further, we expected that five year olds would not develop programming skills in even the simplest form.

DESIGN OF STUDY

Theoretical Base

This project undertook the challenge of translating the cognitive developmentalist view into teaching strategies for introducing non-readers and beginning readers to interactive computer activities. Such a task required a learning environment with maximum access to interactive computer experiences while simultaneously offering choices of other activities traditionally popular with young children in an action-based learning environment.

In terms of child development and learning, both researchers were strongly committed to that view of child development which gives weight to cognitive stages as a major determinant of how children learn and what they learn. Specifically, we accepted Piaget's definition of the characteristics of the thinking of the preoperational child with special emphasis on the midpoint of this period, the five year old:

1. perception bound:
   (a)perception tends to override logic
   (b) can deal with only one point of view at a time when using variables
   (c)limited ability to conserve, i.e. maintain an understanding of continuity of properties of objects and events despite changes in the way

things seem to be.
2. precausal: tendency to explain events in terms of concurrent events, animism, or superhuman forces.
3. preclassification and beginning classification thinking: limited ability to deal with part-whole relationships, hierarchical relationships and class inclusion.
4. limited ability to use reversibility in thinking, focusing primarily on one-way direction of events. (16)

It was our belief that the kind of learning environment which best conforms with young children's developmental needs is action-based with opportunity for children to select materials, choose tasks and establish their own timing and pacing. We were convinced that observations of attention span, social interaction patterns, learning content and patterns, and teacher strategies would best serve the information needs of our study if completed in a setting where children's choices were valued.

Selection of age group

We selected the kindergarten-aged child as our target population, since the five-year-olds represent the midpoint of the early childhood period and also represent the national norm for beginning public school experience.

Population

In order to avoid the demands of standard school programs, we opted to do our research in an out-of-school or extra-curricular structure. The Queens College Saturday morning children's program offered access to a multi-ethnic, multi-racial group. Of necessity, this group represented families who were interested in providing their children with extra-curricular educational experiences and who were willing and able to pay the modest fee as well as give up Saturday time. The program was advertised as a specially designed program to introduce kindergarteners to computer experiences in a setting with many kinds of materials. Children were enrolled by mail on a first-come, first-served basis, with the only criteria that the child be currently enrolled in kindergarten. We did not see the children until the first day of classes.

Ten children, seven boys and three girls, were enrolled in the fall for the first eight-week cycle of weekly 90 minute sessions. Twelve children, nine boys and three girls, were enrolled mid-winter for the second cycle. For the third cycle, in the spring, we selected those children from the

first two cycles who evidenced a sustaining interest in pursuing computer-related experiences. By chance, selection included eleven children, one half of the population we had served. Of these, 10 were boys.

Computer Room Setting

The computer room which served as the site of the class housed 15 Apple II+ machines. We had sufficient additional space for use of traditional early childhood materials and specially designed games and activities in the room as well as in the carpeted adjoining corridor.

Computer Activities

The primary computer activity was Keystroke LOGO, an adaptation of LOGO which is considered age-appropriate because it avoids the need for mastery of two and three digit numbers and reduces keyboarding demands. It does require the use of the RETURN key, thus establishing the procedure of typing a command and then requesting execution of the command. As children gain mastery over reading the textscreen where the typed commands appear, they can discover that they have the opportunity to change their commands before execution. For non-readers, we used green dots to color code the F and B keys, which were programmed to produce a 20 turtle step line forward or back. Small red dots marked the R and L keys, which were programmed to produce 30 degree turns to the right or left. The C key, for clearing the screen and centering the turtle on screen, had a black dot and the RETURN key had a white stripe on it. The color codes did not mask the letters on the keys.

Activity Choices

The variety of materials and activities available in the setting from the beginning included the following:

1. kindergarten blocks, equivalent of a half of a kindergarten set and accessories
2. three sets of small colored cubes with pattern cards
3. crayons, paper and tracing stencils of standard geometric shapes
4. small stuffed animals
5. magnaboard
6. lego board
7. 15 computers, with keystroke LOGO and a target activity
8. printer
9. two Big Traks

Materials and activities that were added gradually, as shown

in Appendix A include:

1. Etch-a-sketch
2. geoboards and rubberbands
3. boardgame 1, with spinners
4. boardgame 2, with a track and cards
5. lotto
6. computer task cards
7. three decks of command cards
8. hard copies of mazes for crayoning
9. graph paper crayoning activity
10. additional LOGO commands

LOGO computer activities included:

1. five levels of mazes
2. two target activities
3. three retracing activities
4. geoboard
5. alphabet manipulation
6. tictactoe with happy and sad faces and O and X
7. regular LOGO

Except for the Kindercomp DRAW program, the following software programs were not made available to the children until the spring cycle, with the high interest group.

1. Kindercomp (Spinnaker)
2. Story Machine (Spinnaker)
3. Moptown Parade (The Learning Company)
4. Facemaker (Spinnaker)
5. Juggle's Rainbow (The Learning Company)
6. Gertrude's Puzzles (The Learning Company)

Teaching Strategies

As we designed the project, we specifically planned to encourage children's problem-solving skills by providing sufficient information and then asking questions to help them further explore options for problem resolution. We were particularly interested in fostering exploration for discovery and experimentation for problem-solving. Further, we were committed to using scientific or objective language rather than anim tic language in order to help children acquire an under anding that the computer does not have decision-making capacity - it has no will of its own.

The three primary teaching approaches projected were (1)invitation to tasks, (2) stimulation to continue exploration and complete tasks, and (3)direct instruction.

We expected to also use the standard teaching behaviors associated with an early childhood, action-based learning environment such as fostering social interaction, maintaining classroom order, and communicating a sense of

teacher caring and sharing.

Data Collection

Beginning with the first session, all sessions were audio-taped. When activities were planned for both the adjoining hallway and the classroom, we used two recorders. In addition, during the first four sessions of the first cycle, the teachers entered involvement and activity information at 10-15 minute intervals on coded charts. At the end of the fourth week, we discontinued written entries and initiated a procedure of dictating the same information into the tape recorder.

During the second cycle, an independent observer attended seven of the eight sessions and maintained anecdotal records of children's involvement with each other at the computer and with the traditional early childhood equipment. At the end of each session, the observer and the researchers discussed the events of the session, taping the discussion.

During the third cycle, in addition to the above mentioned data collection procedures, three sessions were video-taped, using two VTR's on tripods at opposite ends of the room. A technician was responsible for both machines.

IMPLEMENTATION

The following section includes observational data from each of the three eight-week cycles in terms of (1)children's involvement in learning activities (2) children's computer skills and understandings and (3) teaching strategies.

Overview of Fall and Winter Cycles

Based upon an introductory discussion at the beginning of each cycle, we found that children's understanding about computers ranged from total ignorance to considerable familiarity with how the keyboard looks and how some computer games are played. Although a few children reported having home computers, children's access to these computers seems to have been severely restricted. As one child reported, "My Daddy lets me use the computer whenever I want, as long at it is turned off and unplugged."

Following initial direct instruction on Keystroke LOGO, children were invited to experiment with the drawing commands at a computer, alone or with a friend. A simple

target procedure was provided as an option to drawing.

Similarly, after initial demonstration and guided practice with the programming function of Big Trak, the children were invited to experiment with programming it.

During the first two sessions of the fall cycle, children related to the computer environment as if it were a free play period in a kindergarten classroom. The major portion of their choices reflected a preference for familiar materials and activities.

In contrast to the fall cycle, children in the winter cycle became completely engaged by the computer during the first session. Their eagerness to find out all they could about the computer sustained them for almost the whole period. During the second session, they explored the rest of the setting.

Children entered the third session in both cycles displaying a strong interest for computer activity. During this session, children's involvement began to reflect their interests, abilities and learning styles. Three patterns were emerging, those children who were building interest and skills at the computer, those who were building skills but no interest, and those who were building neither skills nor interest.

From this session on, the group of computer-involved children generally increased the length of each engagement at the computer as well as the cumulative time per session. By the eighth session, computer-involved children were spending approximately 60 minutes of the 90-minute session at the computer. The 30 minutes of non-computer time centered primarily on blockbuilding and crayoning.

The other two groups increased their block play and dramatic play, as well as devoting segments of time to socializing without materials. They reduced their computer involvement to approximately 10 minutes per session.

Overview of Spring Cycle

Since the spring cycle included only those children we identified as belonging to the high-computer interest group, the children's emphasis was on computer involvement. After having done the mazes and other LOGO computer tasks many times they began to request other computer activities. See Appendix A for the sequence of activity offerings during

this cycle.

As we introduced additional software packages, we noted that the children were using their experiences with LOGO as the base on which they evaluated the new software. They sought the same degree of control as they had experienced with LOGO and constantly asked us how to erase, stop a segment, skip a task in a segment, and enter their own items in a segment. Typically, they learned how a software package worked and then experimented with achieving their own effects. They learned how to handle disks, load a program, and watch the disk drive light for information about when to remove the disk. As the cycle progressed, we noted that the children usually used LOGO once during a session, plus using one or two other programs. LOGO activities were usually independent, while commercial software activities usually attracted teams or small groups. All children used the standard kindergarten materials every session. For the teachers, this cycle was the hardest working cycle due to the fact that the children were dealing with a number of different software packages and were still unable to read much of the written instructions or to understand those messages they could decode. For example, Moptown Parade fascinated some children, but they could not read the request for attribute selection, so an adult was needed most of the time.

Children's Involvement

We noted three distinct intensities of involvement related to the computer activities:

High computer interest
4 children, fall cycle; 8 winter cycle; 11 spring cycle.
Two patterns of learning were emerging:

a. Aggressive experimenters, whose experimenting gained momentum with peer interaction.
b. Tenacious experimenters, silent and "loners", who enjoyed adult and peer reinforcement, but did not overtly seek it.

Medium computer interest
2 children, fall cycle; 3 winter cycle; 0 spring cycle.
Involvement was based on ability to follow instructions, but not on an interest in experimenting and gaining control from own efforts. Therefore, they completed instructions relatively accurately and then left the computer to use other materials.

Low computer interest
4 children, fall cycle; 1 winter cycle; 0 spring cycle. The behavior of this group was characterized by periodic fingering of the computer keyboard and brief observations of what others were doing at the computer. They were unable to make connections between their own explorations at the keyboard and computer output. For them, the most engaging part of the experience occurred when they requested an activity set-up such as a maze. They would use the keyboard to request the activity, passively watch its formation on screen, erase it and then do it all over again, as if watching television. Children in this group were more typical of the peer-oriented five-year-old whose major choice of learning activity involves manipulative and dramatic play materials. Although they enjoyed the computer-related crayoning tasks, these tasks did not bridge to the computer for them.

Using any of the criteria, (a) choice to engage, (b) degree of involvement or concentration, (c)content of interactions, and (d)investment of own ideas into the learning activity, the computer experiences failed to qualify as vital instructional or learning materials. Initial curiosity was quickly dissipated by brief contacts during the first few sessions and did not reappear as the cycle progressed. They used board games more than they used the computer, however not as much as the traditional early childhood materials. When using Big Trak, they set it into forward motion, using an indiscriminate sequence of numbers and then watched it knock down block structures and bump into walls.

Children's Learning Strategies

The remainder of the descriptions refer to the high computer interest children. At the computer, the children used many strategies to understand the relationship between events that occurred and to develop the ability to control events, that is achieve mastery. These included:

(1)exploring and discovering
  (a) turtle commands
  (b) keyboard possibilities
  (c) machine operation, including moveable parts
  (d) software possibilities
(2)redoing activities in a variety of ways
(3)creating, using what they learned in order to produce unique effects

Verbalizations and social interactions permeated the use of these three strategies. We can best document the behaviors

that were accompanied by verbalization.

Exploring and discovering with microcomputer experiences
Verbalizations surrounding exploration and discovery were questions and declarations of new learnings. They sought information related to their own investigations and those of others, that is "How can I do...?" and "How did you do? Typically, we noted such questions as:

How do you erase?
What's that key for?
How do I make it go this way?
(Ch. to T) I don't know how to make it go right.

Once they learned some things, they were eager to teach others. Spontaneous peer teaching was observed, as were spontaneous requests for it. It was seen when one child observed another child working at the computer or when a child discovered a way to achieve an effect and announced it to the general setting. Such announcements often generated interest from others who came over from all areas to check and then returned to their own tasks or tried the new idea on a machine. Samples of verbalizations related to this behavior included:

I'm clearing it. Watch! Watch the computer. Don't watch my hands.

He made a mistake, but I helped him.

This is the turn button and this is the left button.

Look. I made a circle, now a square. Press this button. (and you can do it too.)

(Referring to a maze on the monitor) I didn't do it. Two M's did.

J. when you want to go to the circle, you have to use the R button.

You pressed the wrong button, but I can clear it up anyway. You can go backwards by B.

Do you want to know how I did this?

Look what TT can do! (produces target activity)

A more subtle form of information seeking was reflected in the following statement:

(Ch. to ch) Next time we come here, I'll use your machine and you use this one.

Occasionally, we observed another kind of peer teaching, two children on different computers doing identical tasks, such as moving through identical mazes, each announcing what moves they were making to get to the end.

Doing and Redoing: Testing and Experimenting

Once children had acquired a body of information through exploring and discovering, they began to test their knowledge by doing and redoing the same tasks, introducing variations or experiments little by little. For several weeks, five children began the session by redoing every LOGO task they knew, starting with the first one learned and proceeding in sequence through the repertoire. The children's sense of accomplishment and ability to command the machine were reflected in a variety of verbalizations.

I did it and then I erased it.
Let's do the mazes.
You want to play tictactoe with me?
I finished the maze. Now I'm going to do another one.
Mrs. S. Come and see. I did it.
(See Appendix B2 for further examples.)

At the crayoning table, one of the favorite computer-related activities was crayoning pathways through the printed mazes.

We also saw evidence that this new knowledge was merging with and altering what they already knew. Initially some children called the maze a small house, but as they dealt with the different sizes and shapes of mazes, they changed their view. Notions of measurement, especially in terms of longer-shorter and bigger-littler were used extensively, as children spontaneously made such comments as "too long", "too far", "need more F's", "turn one more R", and "now it's too big."

Children's lack of knowledge accounted for some problems. The difficulty children had in understanding the difference between changing heading by pivoting and changing position by moving forward or backwards continued to resurface as they introduced variations into the tasks.

We distinguished experimenting at this doing-redoing level from experimenting at the next level of creating in terms of the basic task. If children were using the computer

activity within the context it was designed, we categorized the behavior as testing what has been learned, e.g. going through the maze by a different route, reversing the order of approach to the targets or surrounding a target instead of moving through it. If they changed the activity task, as described below, we labeled that creating.

Creating - combining new knowledge with the old
Children used their new computer skills in unique ways to create products of their own design drawing on prior knowledge. In addition to creating pictures, they altered existing activities and created their own versions of games.

They produced the pictures typical of beginners, such as box, house, combinations of standard geometric shapes and freeform designs of open and closed shapes. More advanced computer drawings included a stick figure complete with facial features, a spaceship on a launching pad, a telescope, a boat and a replica of the World Trade Center's twin towers.

Variations they made on our computer tasks were (a) an extension of a maze by adding a pathway around the outer edge, (b) use of the tictactoe faces as a base for drawing a human form, and (c) use of the four-target activity as a baseball diamond to play a game.

Additionally, one child designed his own interactive game by making a set of 21 incomplete, adjoining boxes. He invited others to complete a box.
Sample verbalizations include:

> Guys look! I made a rectangle of squares, 21 squares.
> (When drawing a picture) I want to draw it diagonally.
> I'm drawing the U.S.
> Now I'm going to draw the Empire State Building.

They compared shapes created by chance with standard geometric shapes, and they used their knowledge of shapes to guide their replications. Familiar images were reproduced on screen and again with crayons.

Computer Wisdom

In addition to documenting children's learning strategies,

we are able to describe the kind of understandings some children were generating about the computer and their relationship to this technology. We expected children to evidence animistic and magical explanations for explaining the relationship between events that are embedded in the technology and language of the computer. We were unexpectedly surprised at the ability of the children to increasingly objectify the technology, to see it as a logical machine in which output relates to input. We found indications that some children had gained a sufficient sense of themselves as controlling agents that they depersonalized not only the computer but also "turtle".

> How do you put the pencil of the turtle down?
>
> I did some more designing with turtle on my machine.
>
> (The adult was calling up a file for the children to use.) Are you going to teach the computer how to do something?
>
> I don't remember how to make the pencil of the turtle walk with black.

Yet this last child who clearly understood his power over turtle graphics, when confused, personalized the machine. When talking about why he did not like the software called Story Machine, he stated: "What I don't like about the computer is when I'm playing Story Machine and the computer won't let me put in a certain word. I don't know why he does that."

An incident reflecting a child's attempt to process the unexpected 'wrapping' behavior of turtle occurred at the drawing table. A child drew a picture of a house with the roof coming up from the bottom of the paper, as if the turtle had wrapped over the top and was finishing the drawing up from the bottom.

Teacher Strategies

We analyzed the data transcribed from audio and video tapes in terms of what kinds of teaching strategies we used in our efforts to create an environment which features discovery, construction of knowledge and autonomy. The major portion of the transcribed data focuses on children's involvement with computers since it is there that they had the greater need for supervision and help..

We categorized teacher's verbalizations in terms of

function:

1. engaging and re-engaging children's involvement
2. fostering problem solving
3. encouraging a sense of control of one's environment through gaining control over the computer as a mechanical object
4. fostering social values and self-valuing through interaction with peers and adults.

The process of providing information was an ongoing function in all categories listed above. Following the initial introduction to LOGO and the commands for Big Trak, all direct instruction occurred in context with individuals or small groups. Direct instruction served several purposes: (1)to invite to a task when we demonstrated a new activity, such as use of a tictactoe grid, (2)to remind children when they forgot a command and, (3) to inform children of new commands currently needed but as yet not taught.

Teaching strategies focusing on engaging and sustaining children's involvement through verbal exchange featured open-ended invitation to tasks and suggestions for specific activities. These invitations to tasks at the computer required an increasingly larger selection of computer activities. As shown on Chart I, availability of computer activities increased through each cycle, however, the first cycle did not have the range of activities that the other two had. This is due partly to the fact that the first group did not show a need for the greater variety.

Similarly, invitations to use Big Trak as a programming toy required specific models of ways to extend its use. We introduced the following challenges:

1. predicting destination when selecting numerical inputs
2. programming Big Trak to reach targets
3. programming Big Trak to follow a paper pathway
4. creating pathways with blocks and then programming Big Trak to travel along the pathways.

In order to stimulate the use of board games, a teacher invited a child to play with her. As the group expanded and some players showed mastery of the game procedures, the teacher relinquished the participatory role.

Teacher invitations took the form of open-ended invitations and specific suggestions:

What would you like to do?
Would you like to try another maze?

Further examples are included in Appendix C1.

Transcribed strategies for problem solving were relatively limited. We alternated between helping children solve problems and doing it for them. Helpful strategies were ones which focused the child's attention on the problem to be solved, such as: "Which way do you want the turtle to go?"
Strategies we viewed as failing to help children solve problems were reflected in offering solutions without examining the problem, such as: "You are missing the target. Do you want to turn it (turtle)?" With experience, we increased our questioning for problem identification and solution and decreased our provision of answers.
(See Appendix C2)

One of the approaches to help children gain a sense of control over the computer was to dehumanize it by emphasizing the relationship between user actions and machine reactions. Statements which avoided the animistic view included:

> Are you getting the turtle to move around OK?
> What do you have to type to move the turtle in that direction?

As novices in the world of using child-appropriate, non-animistic computer language, we faced some difficulty in maintaining consistency of language. A typical example of our difficulty in this area is reflected in the following statement which was intended to encourage a child to type accurately:

> Remember, the computer is very stupid.

(See Appendix C3)

Fostering of social values is a universal concern in all educational settings. The forms it took in our project, which are listed in Appendix C4, include encouraging peer interaction to learn from each other, to teach each other, and to demonstrate caring. We communicated our valuing of sharing one's sense of "I can do", "I can create", and "I can learn" with such comments as:

> Look what you did!
> We're going to save this picture that J. worked very hard on.

Efforts to help children bridge from the three dimensional world to the two-dimensional world included (1) drawing crayon pictures of children's block constructions and (2) drawing crayon pictures of children's LOGO drawings. Efforts to provide activities which would serve as a bridge

between children's developed interests and the new materials included hard copies of mazes and paper copies of board games for crayoning.

DISCUSSION

The fact that in our selected population of 22 children, eleven failed to demonstrate the same vitality of learning with the microcomputer as they did with the other concrete materials in the environment poses an interesting dilemma for professionals involved with kindergarten-aged children. If the theoretical commitment is to provide learning opportunities in which young children learn through active engagement with what is in their environment, we have to say that it is likely that at least one half of the kindergarten population cannot effectively use an interactive microcomputer experience such as LOGO. However, the other side of this coin is that there is a population of children in this age group, percentage unknown, who will exercise considerable learning vitality in a high-access computer environment stocked with a variety of other learning materials. We have developed some insights related to this high interest group that can guide further studies.

The kinds of learning behavior we documented with the high interest group represent the same purposeful behavior which can be observed in any action-based learning environment where children engage in activities by choice. In such a setting, when children are concentrating on a self-selected task, they resist being interrupted. The same intensity was evidenced when the high-computer interest children were learning to master the LOGO keystroke commands. The right to learn at one's own machine seemed essential. We think that the reason children did not choose to share machines when they were learning to master the command system is due in part to the uniqueness of the challenge to each individual child. In order to figure out how the events linked to their own actions, they needed to have time to choose an action, produce it, observe outcomes and then process the experience, all at their own speed. It was our observation that when others interrupted this sequence, children shifted their attention from figuring out the relationships between keyboard actions and screen events to social interactions.

Interest in social interactions seem to be dependent upon having something to share. When they discovered a relationship or produced an effect, interest in sharing surfaced as a major element in the environment.

What we were seeing was a pattern of independent learning with the interactive programs followed by keen interest in either learning more or sharing what had just been learned. Interestingly, this pattern changed dramatically when children discovered some of the drill activities in the commercial software programs. Suddenly, spontaneous partnerships developed at the computer. Partners tended to check with each other before pressing a key, e.g. to match a letter on screen, or fill in a missing number. It was our impression that the children found safety in numbers as they dealt with experiences that required correct answers. Despite the conflicts that accompanied partnerships, the children declined to use these software programs independently when the opportunity was offered.

This contrast in the way children reacted to the different types of computer experiences poses some interesting questions. Can we use the conventional early childhood commercial software packages to support independent learning? Can we pair young children at a computer with interactive activities and achieve an intense and sustaining involvement in the learning experience?

We obtained some clues related to the concerns about children's needs for external rewards for computer successes. We found that after the initial exposure to the colorful graphic and sound rewards in commercial software, our children lost interest, as manifested by their pursuit of other activities during the sequences designed as rewards for accuracy. When using LOGO, the children produced their own rewards, gaining satisfaction from their accomplishments and engaging their peers in sharing their interest and success.

We did not value the contribution that Big Trak made to the learning environment. Since we were unable to successfully engage children in wanting to use the programming capacity of the floor toy, it became a novelty item, misused and broken.

We faced some problems adhering to our original plan to use objective language during direct instruction. We attribute this to the following:

1. Initially, we did not have the fluency of vocabulary associated with Turtle graphics. Consequently, we found ourselves using animistic language unwittingly when referring to Turtle and to the computer. This took the form of using masculine and feminine pronouns referring to Turtle and labelling the computer "stupid"

to explain the need for accuracy in typing. As we heard this animistic speech on the tapes, we were able to reduce our use of such language.
2. We also had problems in refining our strategies designed to foster problem solving. It was difficult to distinguish between computer problems children could solve, problems we needed to help them solve, problems adults needed to take care of and those problems that could be ignored. While we increasingly refrained from offering solutions quickly and opted for questioning as the initial approach, we found that this problem to be as confounding with computer activities as it is with all teaching in an action-based learning environment. Although experience has taught us a great deal about how to encourage children's problem solving in using such materials as blocks, we do not yet have that well of computer teaching experience from which to draw.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

In contrast to our initial hypothesis, we found that some five year olds not only can, but also will, choose interactive microcomputer activities as useful experiences to exercise their need to know and control their environment. They will bring to bear prior knowledge and understanding at the microcomputer just as they bring it to bear with blocks and other traditional early childhood classroom materials.

Our hypothesis that five-year-olds would not develop programming skills in even the simplest form was substantiated. Despite direct teaching at timely moments, when children's interest indicated readiness to learn to use multiple commands on a line, children did not use this new knowledge independently.

Recommendations

For early childhood professionals who value the cognitive-developmental view and an action-based learning environment, the following criteria are recommended for designing a model for computer use with young children:

1. Children have choices to use the computer or other appropriate early childhood materials.
2. Children may use the computer alone, without demands to share during the actual use time.
3. First experiences at the computer are restricted to Keystroke LOGO and support activities.

4. At least two computers are provided so that there can be interaction between children working simultaneously at the computers.
5. A printer is available for making hard copies of the children's work.
6. A knowledgeable computer-user who also understands the way young children learn is actively supervising the children's experiences.
7. There is a maximum teacher-child ratio for computer users of one teacher to five children.

Further research needs

The researchers see a need for further documentation on the effects on the learning of young nonreaders and beginning readers associated with experiences in a materials and activity rich environment including Keystroke LOGO on computers. Before comparisons are attempted between different theoretical approaches to the use of microcomputers with young children, more information is needed within this theoretical model.

FOOTNOTES

(1) Preliminary findings from this study were reported by Schwartz in Microcomputers and Young Children: Using Research to Plan Programs, Paper presented at National Conference on Computers and Young Children, University of Delaware, Newark, Delaware, April 5-6,1984. A revision of this first paper is in press as an occasional paper published by Queens College School of Education, Queens College, CUNY, Flushing, N.Y., 11367.

(2) A sample of articles in print at the time of this study about the contribution of computer experiences to young children's learning included references to LOGO as well as commericial software. Asbell, 1984: Burg, 1984: Hines, 1983: Hoot, 1983: Hungate, 1982: Kramer, 1984: Lawler, 1982: Piestrup, 1981.

(3) One of the continuing challenges facing early childhood professionals is to coordinate recommendations for practice with theoretical foundations stemming from views of child development and learning, views of knowledge and views of the role of school in society. Schwartz and Robison, 1982.

(4) Bowman, 1983: Brady and Hill, 1983: Hill, 1984: Sheingold, Kane and Endreweit 1983: Spencer and Baskin, 1983. One of most comprehensive statements of this position published in the summer of 1984 was written by Cuffaro.

(5) Conferences devoted solely to a consideration of the place of the new technology in the lives of young children were held at Teacher's College, Columbia University, N.Y.C., June, 1983 and at the University of Delaware, April, 1984. Campus-based preschool programs reporting use of computers with young children included locations at University of Delaware, University of Maryland and Stanford University.

(6) Discussion of Kohlberg's categories in terms of early childhood curriculum decisions can be found in Schwartz and Robison, 1982, Part I.

(7) AERA,1984 included a symposium focusing on impications of these theoretical positions in terms of designing computer experiences for young children. Papers presented at this symposion included cognitive-developmental view, Bowen, Behaviorist view, Golub, and the humanist or psychodynamic view, Broughton, and a discussion, Schwartz(AERA, 1984).

(8) A more complete discussion of these three categories

suggested by Taylor, 1980, in terms of coordination with traditional action-based early childhood programs was included in the preliminary paper on this project presented at Delaware Conference, Schwartz, 1984, p. 3-5..

(9) See complete issue of Byte magazine, August, 1982 for full range of expression of these expectations of the potential impact of LOGO originally articulated by Papert, 1980.

(10) Miller, 1985, p. 10.

(11) Brady and Hill, 1984, p. 50

(12) ibid.

(13) A typical study of this kind was cited by Cron, 1983. According to Cron's report of a masters thesis research project at a California college, the research included children from kindergarten through grade seven. Pretest-posttest comparisons on children's abilities to estimate length of lines and curves, to assess segment-to-whole relationship; and to follow directions on a graph, according to Cron's summary, "showed that all children, regardless of age, had the same gains in learning." Because the enormous difference in the way five-year-olds understand mathematical relationships as compared to 13 year olds, such findings raise more questions than they answer.

(14)Hungate, 1982: Piestrup, 1981: Hallworth and Brebner, 1980.

(15) Paisley and Chen, 1982: Spencer and Baskin, 1981.

(16) Some of the finest analyses of Piagetian ideas about how young children construct understandings or knowledge have been done by Forman and Kuschner, 1984, and Kamii and DeVries, 1982.

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APPENDIX A1 - LOGO COMPUTER ACTIVITIES

SCHWARTZ & LEIBSON

	FALL SESSION								WINTER SESSION								SPRING SESSION							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
F,B,R,L,C COMMANDS	I	✓	✓	✓	✓	✓	✓	✓	I	✓	✓	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
TARGET ACTIVITY (T)	I	✓	✓	✓	✓	✓	✓	✓	I	✓	✓	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
HARDER TARGET (TT)		I	✓	✓	✓	✓	✓	✓		I	✓	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
INITIAL RETRACE		I							I															
Maze (M)		I	✓	✓	✓	✓	✓	✓	I	✓	✓	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Maze (MM)			I	✓	✓	✓	✓	✓	I	✓	✓	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Maze (MMM)				I	✓	✓	✓	✓			I	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Maze (MAZE)															I	✓	R	✓	✓	✓	✓	✓	✓	✓
GEOBOARD (G)													I	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
QUADRANT (Q)											I	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
BOX1 (maze)																	I	✓	✓	✓	✓	✓	✓	✓
TEEPEE (retrace)																	I	✓	✓	✓	✓	✓	✓	✓
HIDE AND SEEK																			I	✓	✓			
ALPHABET																						I	✓	✓
OCT.MAZE																						I	✓	✓
HOUSE (retrace)																						I	✓	✓
TICTACTOE (TTT)																							I	✓
REGULAR LOGO							I	✓						I	✓	✓	R	✓	✓	✓	✓	✓	✓	✓

I = Introduced
R = Reviewed
✓ = Available/Used

APPENDIX A2 - COMPUTER LOGO COMMANDS AND PROCESSES

SCHWARTZ & LEIBSON

	FALL SESSION								WINTER SESSION								SPRING SESSION							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
PENUP & PENDOWN					I	✓	✓	✓			I	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Erase (ESC Key)									I	✓	✓	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Request for color									I															
HIDETURTLE/SHOWTURTLE										I	✓	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
PENCOLOR #										I	✓	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Multiple commands on a single line											I	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Math - Addition												I	✓	✓	✓	✓			R	✓	✓	✓	✓	✓
CATALOG													I	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
CTRL-F (FULLSCREEN)													I	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
BACKGROUND #													I	✓	✓	✓				R	✓	✓	✓	✓
CTRL - C															I	✓	R	✓	✓	✓	✓	✓	✓	✓
READ ".....																			I	✓	✓	✓	✓	✓
Booting a disk																			I	✓	✓	✓	✓	✓
Wall chart for PC																						I	✓	✓
Printouts (with active child involvement																			I	✓	✓	✓	✓	✓

I - Introduced
R - Reviewed
✓ - Available/Used

	FALL SESSION								WINTER SESSION								SPRING SESSION							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Big Trak	I	✓	✓	✓	✓	✓	✓	✓	I															
Board Game 1 (spinner)										I	✓	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Board Game 2 (turtle trail)														I	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Etch-a-Sketch										I	✓	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Task cards - angles										I	✓	✓	✓	✓	✓	✓								
F & R, B & L cards										I	✓	✓	✓	✓	✓	✓	R	✓	✓					
Colored cubes											I	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Recording Sheets											I	✓	✓											
Lotto											I	✓	✓	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Geoboards													I	✓	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
Crayon Maze																			R	✓	✓	✓	✓	✓
SOFTWARE PACKAGES:																								
1. KINDERCOMP							I	✓						I	✓	✓	R	✓	✓	✓	✓	✓	✓	✓
2. STORY MACHINE																			I	✓	✓	✓	✓	✓
3. MOPTOWN PARADE																					I	✓	✓	✓
4. FACEMAKER																							I	✓
5. JUGGLES RAINBOW																							I	✓
6. GERTRUDE'S PUZZLES																							I	✓

I - Introduced
R - Reviewed
✓ - Available/Used

APPENDIX B: OBSERVATIONS OF CHILDREN LEARNING

B1: EXPLORING AND DISCOVERING

Multiple references to "Look what I did."

Extensive fingering of keyboard, manipulating switches, knobs and moveable parts. Considerable experimenting with OFF-ON switch.

Keyboarding patterns included typing letters in alphabet sequence, QWERTY sequence, keyboard sequence, and typing familiar words, such as their names. It frequently resulted in filling the four lines of textscreen.

Testing what happens when they call up one task right after another, such as superimposing a maze on a target activity.

VERBALIZATIONS

What do the numbers do?

What's that? (referring to the cursor)

Look at my screen!

Look what I did with the turtle. Here press this button.

(Ch. to T.) If you want an E, press ELIE. (one of the activities produced the first letter of child's name, if the name was typed)

(Ch. to T.) Come here! Come here! Look!

Hey, I'm making a rectangle already. (referring to small maze)

How do you get color?

I did it. I had to press the M button two times. (to get a maze)

I have a problem. (system bug)

Want to know what I did? I pressed this one again. First you press the M button and then you do another one.

J. Look at this...OK I'll be right over.

What does the O do?

I did white.

You can go backwards by the B.

I wonder what happens if I do...(child does it)

What's that?(reset button)

How do you get the intercom...on the machine?

What's that square? (referring to cursor)

(In Moptown, when the screen question "Do you want to play again?" appears)
What would happen if I said no?
(T) Finish that one off and then we'll try it.
(Later, when teacher asked what happened, the child replied)
Well, it gave me a whole bunch of words.

B2: USING NEW DISCOVERIES, DOING AND REDOING

DECLARING ACCOMPLISHMENTS AND ABILITY TO DO

I did it and then I erased it.

I hit the circle. (target activity)

Look what I'm around to already. (progress in the maze)

Look! We're both doing the same thing.

(Ch. to Ch.) Let's do the mazes.

(Ch. singing and keyboarding) F..do it..F..do it..F..do it.

(Child going through the maze backward on a different route than he did going forward) Now I'm doing the same thing backward.

(Child talks out loud to self while doing maze) Now forward, now turn...

Are there any harder mazes?

(Working with Kindercomp DRAW) I made stairs and then I went over those steps.

(Ch. to Ch.) You want to play tictactoe with me? (on the computer)

The maze is not like a house because it doesn't have a pointed roof.

(Talking out loud to self while using Kindercomp DRAW) I'm making it go this way and I'm not going to stop until it gets all the way to the bottom.

(Talking to self while changing colors in Kindercomp DRAW) White, blue, yellow, purple...

(Ch. to T.) I want to do a maze.
(T.) Which one?
(Ch.) A hard one.
(T.) Real hard one? Then you have to type MAZE.
(Ch.) Not that hard. I'm going to do 3 m's.
(Another child) Three is a hard one
(Ch.) I know. That's what I'm gonna try to do.
(Later) I'm going to do the hardest maze in the world.

(Four children's conversation on simultaneous uses of a maze with dead ends on four different machines)
(C1) Ah ha. I'm finding a way to get in there.
(C2) That's not the way I get in. (C3) Did you have a little trouble going here?
(C2) No.
(C4) Look. I didn't even do any roving. (moving off the pathway)
(C2) I got there too, but I turned my arrow and I got there the other way.

(Two children use the F key for screen fill in Kindercomp DRAW program. While screen was filling, they moved to a machine with LOGO and worked there while waiting.) Is it done yet? It's getting there.

(Two children on two machines request the fill action on Kindercomp DRAW at the same time, as a form of race.) Let's see who is going to win.

MEETING WITH PROBLEMS

My turtle moved. It's all the ways somewhere else and I don't know where.

(After using LOGO command cards in chance order) It didn't make anything.

(C1 to C2) You're going to have to help me with this maze.

(Working with Story Machine) Hey. What's the matter. It won't take the 'N'.
(T) That's not one of the words..
(C) It is too. See this 'N' word here. (T) Not one of the words you can use to start a sentence.
(C) Oh!

B3: CREATING - USING NEW KNOWLEDGE WITH THE OLD

Producing replicas of block structures using Kindercomp DRAW.

Using keyboard as if it were a piano, singing along.

Using geoboard grid as a base for drawing the letters of his name.

Child uses kindergarten blocks to spell BAT and then replicated it on the computer with Kindercomp DRAW.

Two children converted the four-target activity to a baseball game, taking turns going to the bases.

Child built 'twin towers' with blocks, made a crayon picture copy of it, used picture to guide a computer drawing using LOGO, and then printed out computer drawing.

VERBALIZATIONS

Mrs. S. Want to see my design? I finished my design. Want to see it?

I made a square.

How do you make the turtle don't show anymore? (wants to hide turtle after completing drawing)

I'm gonna make (draw) a harder thing than last week.

I made a rectangle of squares, 21 squares. (Later, remakes it leaving out lines to create an interactive game. Invites people who walk by to finish one of the boxes.)

I made a telescope.

I'm going to make this man. (stick figure) (Spends almost one-half hour on successfully completing task, obtaining help for eyes and to erase a line.)

I'm drawing the U.S.

I want to see what I can make with the computer, with triangles.

I'm making a square. I'm making a triangle next to it.

First I'm going to do a bit of Kindercomp and then I'm going to make (draw) a house (with LOGO) and print it out.

You know what? Now I want to make a building.

B4: DEMONSTRATING COMPUTER KNOWLEDGE

Children learned to use different commands for different programs and often compared the different effects of keyboard commands in different programs.

VERBALIZATIONS

Look what TT can do.

I can't get the arrow back on. (He knows there is a command that will show turtle.)

Could you teach it to my computer for the kids who couldn't see?

(T calls up a file with child watching.) Are you going to teach the computer how to do something again?

Mrs. S. The computer made stuff. (system bug)

Mrs. L. Will you please make a copy of my picture on my computer so we can print it.

How do I erase something without erasing everything?

APPENDIX C: TEACHING STRATEGIES

C1: INVITATIONS TO ENGAGE AND REENGAGE

OPEN-ENDED

T: What do you want to do... do now?

T: Which do you want to do... Logo or Kindercomp?

T: Which one (computer activity) do you want to try?

T: Do you want to try something else?

T: Do you want to start on a machine or with something else?

SPECIFIC

T: You finished the maze. Now do you want to see if you can drive turtle back to the beginning of the maze using a different pathway?

T: You drew your triangle. Why don't you try a square?

T: If you can't draw the whole thing, draw the beginning of it and I'll help you finish.

T: Try to get to a target (on the target activity) by going backwards with the B.

T: Bring your picture back next week and try it again.

T: Do you want to make a picture of what you did?

T: Keep going, H. (encouraging further progress in the maze)

T: Do you want to work on LOGO and teach the machine how to do something?

T: Have you tried BOX1? (a maze)

T: See if you can walk turtle through the turtle track. (a maze)

(After teaching the child PENUP command) T: Do you want to learn some more turtle talk?

T: Look at this maze. You can get stuck in these alleyways.
Ch: Ohhhh.
T: You have to plan ahead.

T: I want to show you something. Do you want to try that? (a new task in LOGO)

C2: FOSTERING PROBLEM SOLVING - including giving information as needed

(The turtle wrapped or disappeared) T: F makes it go one way and B makes it go the other. Let's see if you can bring the turtle back on screen.

T: Show with your finger where you want to draw the line.

PITFALLS: Samples of occasions when teachers provided solutions rather than fostering problem solving

T: What did you forget to do?
VS. What's the problem? What did you do to solve it? What else can you do?

Ch: How can you move without drawing in Kindercomp?
T: Change your pen color to white. (Child already knew how to change pen color and background color in LOGO and to erase in LOGO by changing pen color to background color.)

T: What are you doing for the mouth, making a straight line?

T: You're missing the target. Do you want to turn the turtle?

T: Do you want to go down or up?

T: Keep going. Now you want to turn it.

T: 2 C's won't do it. (to clear the screen)

C3: LANGUAGE TO OBJECTIFY AND FEATURE USER CONTROL

T: How are you doing? Are you getting it (turtle) to move around okay?

T: It's (turtle) missing the target, do you want to turn it?

T: If you want to move turtle around without leaving a trail, press PU.

T: Let me get this ready (booting a program) and then we can teach your computer to do ...

T: "Loading, please wait" means that what's on the disk is being transferred into the machine. It stays until the machine is turned off. We need another disk to load in instructions for F, B...
Ch: Could you do it on my machine for the children who couldn't see in the first time?

PITFALLS - explaining error messages

T: When you get all those letters it means it doesn't know what to do.
VS: Let's see if you made a mistake in giving a command.

T: (explaining a systems bug) Sometimes this machine is very silly.
VS: When this happens it's called a BUG meaning problem, but we can fix it by pressing some keys.

T: Remember, computers are very dumb machines.
VS: If you want something on screen, you have to type the commands for what you want.

T: If you don't follow the computer's rules, it tells you it doesn't understand.
VS: That's a message that you made a mistake in typing a command. This computer is only ready to receive turtle commands, if you type other letters you'll get that message.

C4: FOSTERING SOCIAL VALUES AND SELF-VALUING

T: Did you enjoy playing?
Ch: Yes.
T: Did it matter that you didn't win?
Ch: No.
T: It's such fun playing, it doesn't matter to you whether you win or lose.
Ch: Yeah!

T: The computer is a good place to make a mistake. It's so easy to erase.

STANDARD CLASSROOM FACILITATION

FOSTERING PEER ACTIVITY

T: K. wants someone to play this (board) game with her. Does anyone want to play the game?

FOSTERING PEER TEACHING

Ch. needs help -
T: J. knows how. J., will you help H. with ...?

Ch. to T: How did he do that?
T: I don't know. Ask him.
Ch. to ch.: How did you do that? (gets an explanation)

ENCOURAGING INDEPENDENCE AND CONFIDENCE

T: Are you thinking that you'd like to try something different but you don't know what to do? You can do whatever you want. (gesturing to all the room activities)

T: In this room you can do what you want to do. You don't have to wait to ask.

SHOWING INTEREST AND SHARING PLEASURE OF MASTERY

T: Did you enjoy that?

T: You're really getting very good at that.

T: You really know how to move turtle around.

T: We're going to save this picture that J. worked very hard on.

T: Don't worry about the extra line. Just keep on going.

T: Look what you did!
Ch: Yeah. I went up and then this way and then down.

T: Do you want to save that picture?
Ch: Yes.
Ch. to friend: I'm gonna save my picture.

T to T after child shared a product with one teacher: J. made a rectangle with regular LOGO, not a square, but a rectangle.